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ABSTRACT

In the past years the National Assessment of Educational Progress (NAEP) has released results from a variety of learning areas. The purpose of this paper is to point out male-female differences in achievement across several learning areas. Hopefully, the results discussed here will be used as a basis for examining the possible existence of social and curriculum biases in these areas. Female and male performance in social sciences, mathematics, and science are nearly equal at age nine, but very different by adulthood. For example, at age nine, both sexes do equally well on numerical operation, geometry, and measurement, while males have a substantial advantage by adulthood. Since females have been found to read and write better than males, skills prerequisite for academic achievement, the superiority of males in social sciences, math, and science needs further explanation. It is hypothesized that females do not excell in political areas because social studies classes make it clear that females have not been actively involved in their countries' political decisions. No explanation is offered for why females are less able than males to answer questions concerning the location of the Great Lakes, the source of government revenues, and the purpose of the European Common Market. It is concluded that as sex barriers are lifted, females will be given the opportunity to reach their full potential. (BJG)

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EDUCATIONAL ACHIEVEMENT

AND

SEX DISCRIMINATION

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EDUCATIONAL ACHIEVEMENT AND SEX DISCRIMINATION

A Paper Prepared by
Ina V.S. Mullis, *Department of Research and Analysis*

In the past years the National Assessment of Educational Progress (NAEP) has released results from a variety of learning areas. Results are often reported on the basis of a single area, and the results for the age levels (9-year-olds, 13-year-olds, 17-year-olds and young adults 26-35 years old) or groups (region of the country, race, sex, level of parental education and size and type of community) are discussed. The purpose of this paper is to point out male-female differences in achievement across several of the learning areas. Hopefully, the results discussed here will not be used as ammunition to reinforce the stereotype that women do not have the ability to handle math, science and the social sciences, but as a basis for examining the possible existence of social and curriculum biases in these areas.

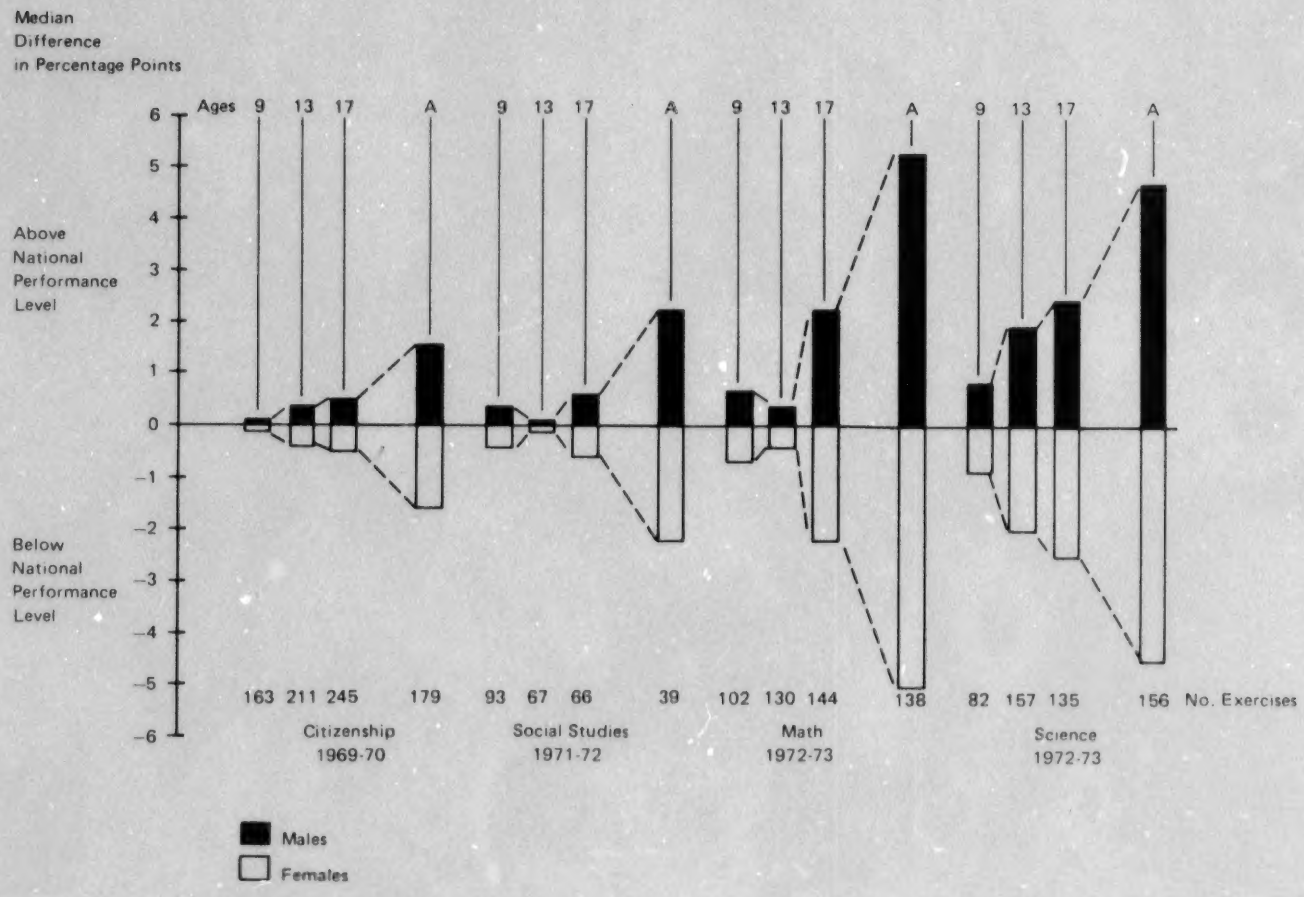
In the social sciences, mathematics and science, male and female performance is nearly equal at age 9. However, what is a slight male advantage at age 9 increases until at the adult level there is a dramatic difference between the performance of the sexes (see Exhibit 1).

These results can be viewed from several different perspectives; however, before any conclusions are reached, results from the assessment of several other learning areas must be emphasized.

* In the 1970-71 reading assessment, females not only surpassed males in most reading skills, they generally also read faster.

EXHIBIT 1.

Median Difference in Performance
between Males and Nation and Females and Nation



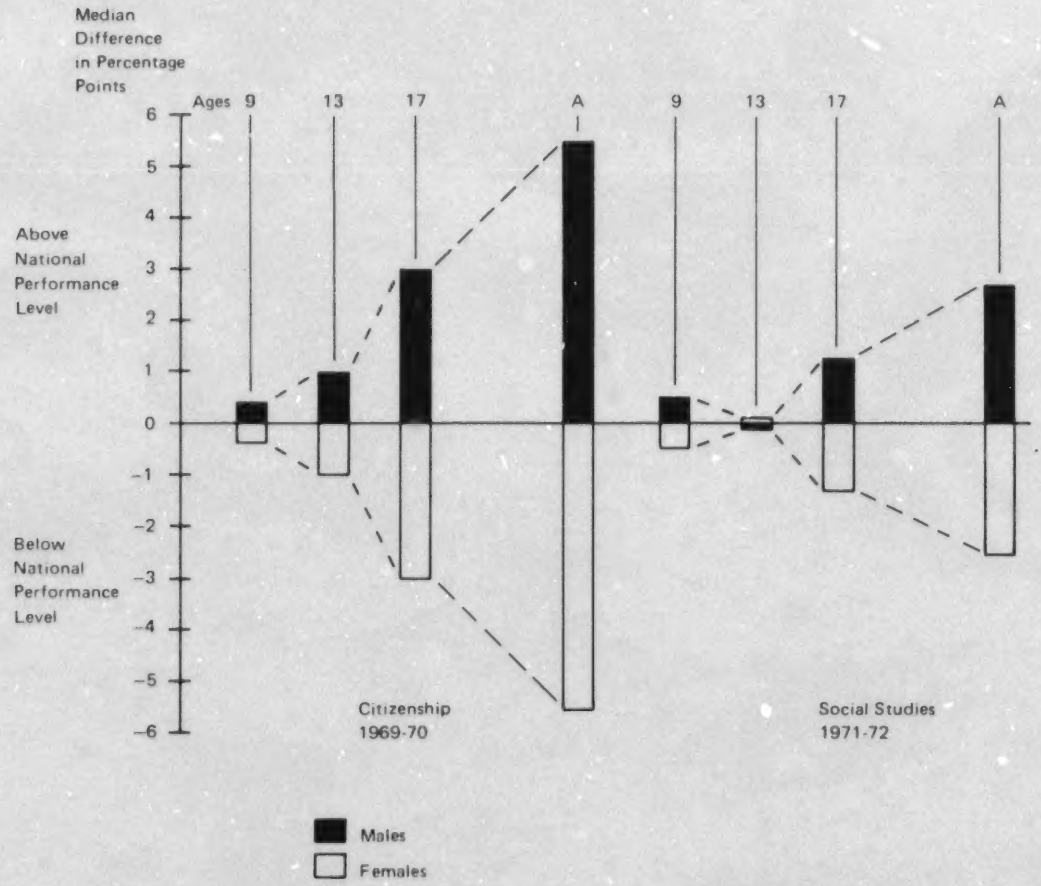
* In both the reading assessment and the literature assessment, girls performed better than boys at all three school-age levels.
* In the writing assessment (1969-70), the median male-female difference favors females at all ages.

The point is made, and supported by other research studies, that females generally can read and write better than males; therefore, one can assume that females do have scholastic ability and have acquired the basic skills necessary for academic achievement. In fact, with a superior reading capability, which includes comprehension, the question of why females do not perform at least as well as males in the social sciences, math and science becomes a very puzzling one indeed.

Insights, but not answers, to this question can be gained from a further inspection of both the citizenship and social studies data. Males did not do better than females on all kinds of exercises. It may come as no surprise that on a group of citizenship exercises dealing with care of the family, female performance exceeded that of males. On the citizenship and social studies exercises surveying attitudes, there is generally no difference between the performances of the sexes. However, for particular kinds of exercises -- those that concern *knowledge* of law, *knowledge* of government and *knowledge* of international problems and politics -- males displayed a substantial advantage over females. The data in Exhibit 2 show the differences in male and female performance for exercises dealing with knowledge of the structure

and function of government. The pattern of a slight, initial, male advantage that increased with age occurred in both assessment areas.

EXHIBIT 2.
Median Difference in Performance
between Males and Nation and Females and Nation on
Knowledge of the Structure and Function of Government



In political areas, there is a possible reason for the differences between male and female achievement. In most social studies classes, it soon becomes evident that females have not been very involved in the political decisions of their country.

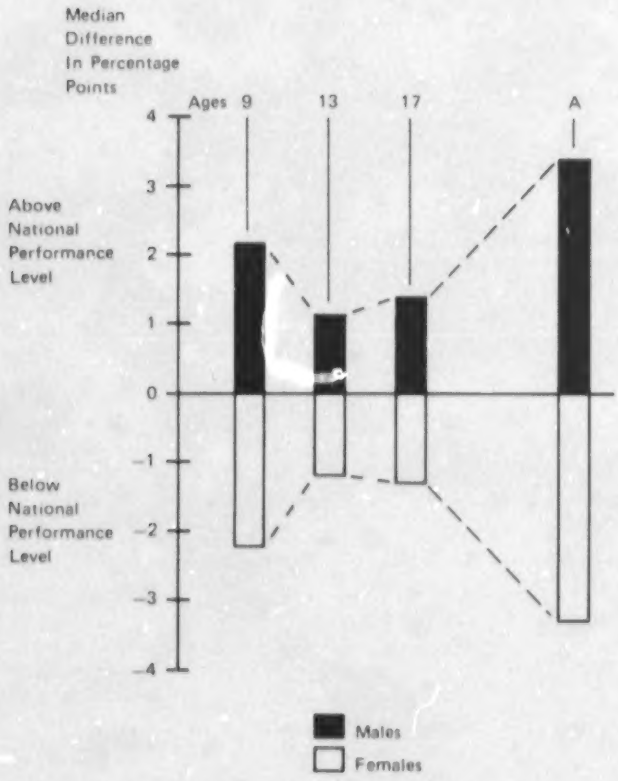
No women signed the Declaration of Independence, have ever been the President or even Vice President of the United States or members of the U.S. Supreme Court. It was not until 1920, 144 years after the founding of the republic, that women were given the right to vote. Even in the 55 years since they have been allowed to vote, few women have had influential roles in government. The number of women that have been governors, U.S. senators or U.S. Cabinet members has been five at most for each one of those positions. This could suggest to many women that political and governmental areas are not their concern and, therefore, not worth learning.

At ages 13 and 17 males were 4 percentage points above females on a multipart exercise dealing with the contents of the Declaration of Independence. At age 9, 5% fewer females (80%) knew that George Washington was our first president. At ages 13 and 17, 8% fewer females than males knew that a president is nominated at a national convention, and 8% fewer adult women than men knew who has to approve a nomination to the Supreme Court. Also, fewer women than men (an 8% difference at age 17 and a 16% difference for adults) knew who has the power to declare a law made by the U.S. Congress unconstitutional.

More difficult to understand, male achievement exceeds that of females on exercises other than those dealing with knowledge of government. Exhibit 3 indicates the disparity in performance on all social studies knowledge items, including history, economics, political science and geography.

EXHIBIT 3.

Median Difference in Performance
between Males and Nation and Females and Nation on
Social Studies Knowledge



On some exercises, it makes little sense that female achievement is below that of males. For example, at age 9, respondents were asked, "Is the Mississippi River in the United States?" and were told to choose either yes or no as the correct answer. Eighty-four percent of the males said "yes" compared to 76% of the females. On another 9-year-old exercise, 56% of the males, compared to only 46% of the females, knew the location of the Great Lakes. At the older ages, males have a substantial edge

over females in the area of geography. On an exercise asking which latitude and longitude would have the warmest climate, 21% fewer 17-year-old females than males and 16% fewer adult females than males answered correctly.

The male advantage is also evident in the areas of economics and foreign affairs. At age 17, 62% of the males, compared to 54% of the females, understood that the government receives the largest portion of its revenues from income tax. At this same age, more males (55% compared to 48% of the females) understood the term monopoly. Seven percent more 13-year-old males than females were able to explain the effects a new highway might have on a community; at age 13, 9% fewer females than males knew the purpose of the European Common Market; and at age 17, 10% fewer females knew the purpose of the United Nations.

In the mathematics assessment, the advantage displayed by males, particularly at the older ages, can only be described as overwhelming. At age 9, three types of exercises were administered: numerical operation, geometry and measurement. The sexes did equally well on exercises dealing with numbers and numeration. Females can add, subtract, multiply and divide as well as males. In fact, 4% more females could successfully add 38 to 19, and 8% more females could subtract 19 from 36. Geometry turned out to be another matter. Males generally had a higher percentage of success on these exercises. A male advantage also occurred on the exercises dealing with measurement.

In addition to the three kinds of exercises administered at age 9, three other types of exercises were administered at ages 13, 17 and adult: (1) variables and relationships, (2) probability and statistics and (3) consumer math. At age 13, again there was no difference between the sexes on exercises dealing with basic numerical operations. Also, on two sets of exercises not measured at age 9 -- consumer math and variables and relationships -- females did as well as males. However, 13-year-old males increased their advantage in the areas of geometry and measurement and displayed an advantage in the sixth type of exercise measured, probability and statistics.

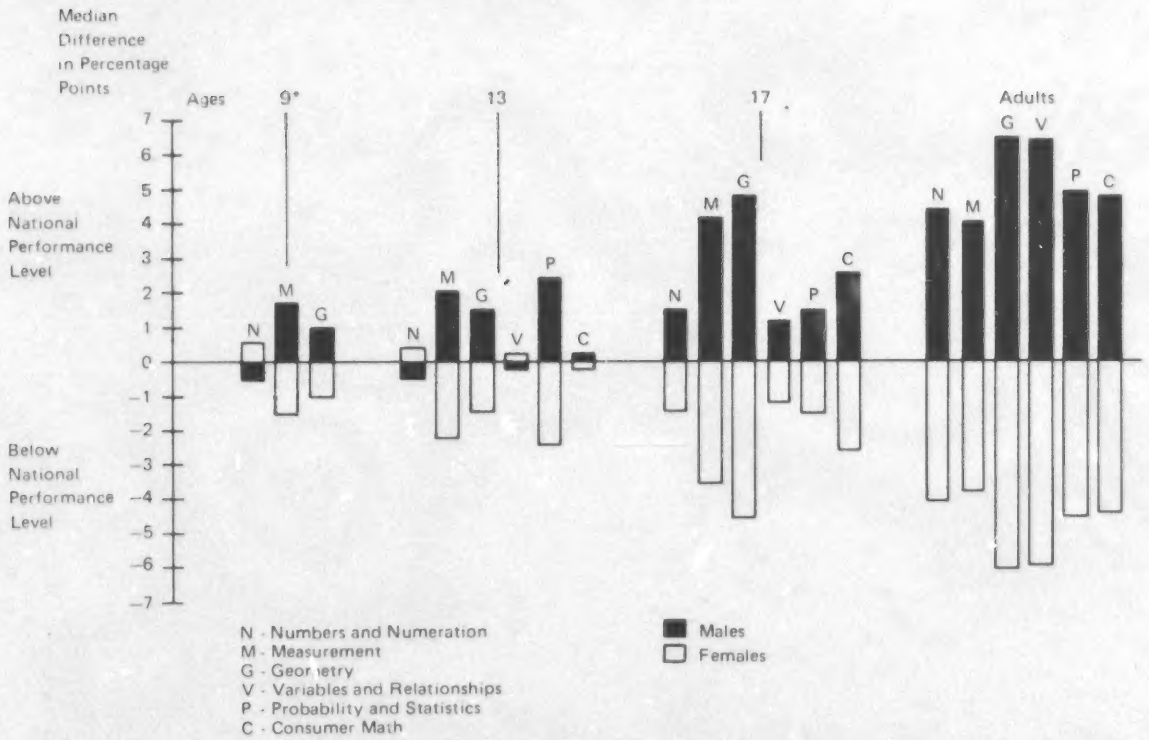
As can be seen from Exhibit 4, by age 17 males had an advantage over females on all six types of exercises. This advantage became substantial for adults.

Females do achieve better than males on some exercises. For example, 9-year-old females were more successful with exercises on adding, subtracting and multiplying. Females also had an advantage in decimal subtraction and multiplication at ages 13 and 17 and in decimal addition at all three of the older age levels.

Females, however, tended to have more difficulty with word problems than with purely computational problems. Again, a puzzling question is raised: If females can do computation and females can read, why do they have difficulty with word problems? Nevertheless, males did have a greater percentage of success on a wide variety of these exercises. For example, 9-year-old males

EXHIBIT 4.

Median Difference in Performance between Males and Nation and Females and Nation on Mathematics Content Areas



At 9 years of age females can do the math basics (add, subtract, multiply and divide) as well as their male counterparts. By age 17, males outperform females in all mathematical content areas assessed.

*Only three types of exercises were measured at age 9.

did better than females on such exercises as finding the difference between a rocket target and the actual landing point, apportioning an equal number of dog biscuits over a number of days and determining how many words a girl missed on four spelling tests. Males at the three older age levels had a higher performance level on two exercises involving the difference in air temperatures and the time required for a car to travel a certain distance.

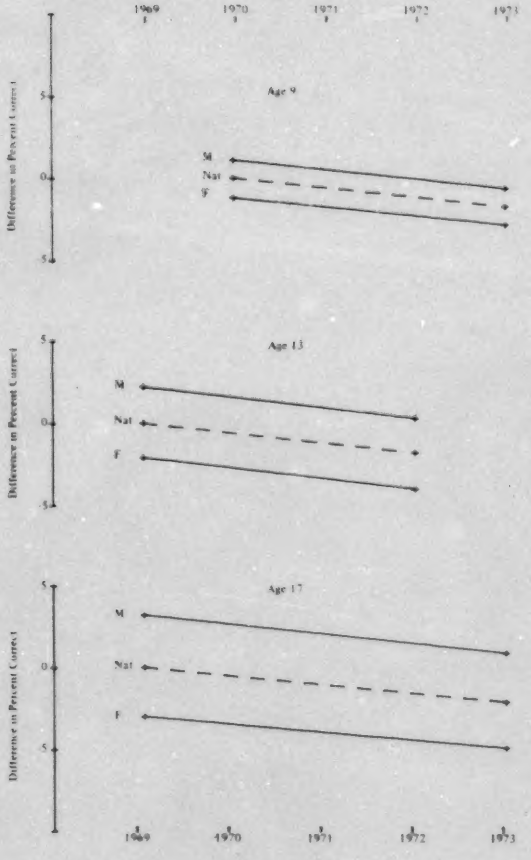
Another inexplicable result from the math assessment was the distinct advantage displayed by males at the older ages in answering consumer-math problems. Females outperformed males on only two exercises -- both about reading sales tax from a table. The male advantage was not confined to any specific type of problem. Sixty percent of the adult males and 50% of the adult females correctly used an excerpt from a federal income tax form. When asked to determine the lowest price per ounce for a box of rice, 40% of the 17-year-old males and 45% of the adult males, but only 29% of the 17-year-old females and 32% of the adult females, selected the correct answer. Male performance on reading a simple mileage chart was 11 percentage points above adult females.

The initial national assessment of science took place in 1969-70. The second one was administered in 1972-73. Both these assessments followed the pattern already established. At the older ages, there is an increasing tendency for males to perform better than females on science exercises. In the three years since the 1969-70 assessment, the gap between male-female performance has not narrowed but has remained the same (see Exhibit 5).

Science assessment results seem more similar to results of the citizenship and social studies assessments than the mathematics findings, in that even at the older ages males did not do better than females on all types of exercises. In fact, if the 1969-70 science exercises are classified as to physical or biological science, there is little difference between male and female performance on exercises dealing with biological science.

However, on exercises dealing with physical science males have a substantial advantage, especially at the older ages.

EXHIBIT 5.
Average Changes in Performance for Males and Females at Ages 9, 13 and 17 in Science



The percentages of males and females that answered a typical science question correctly declined at all three age levels. Furthermore, the gap between males and females remained constant. The performance of 9-year-old boys is, on the whole, 2 to 3% above that of girls. The average performance of 13-year-old boys is still 4% above that of girls. At age 17, average male performance is 6% above that of females.

KEY:

M – Male
F – Female

This pattern of performance was also evidenced in the 1972-73 science assessment. At all in-school ages, females performed about the same as males on exercises dealing with biological science. However, on exercises dealing with physical science, the difference between male and female performance favors males and increases with age.

This finding is consistent with expectations one might have. Boys and girls alike tend to be exposed to physical and biological science topics in elementary grades. In high school, science courses, especially physics and chemistry, become elective. For some reason, boys more frequently than girls choose these courses. Thus, this differential exposure may explain the male advantage in the science results. The question remains as to why more boys than girls choose to take science courses. The self-selection out of the sciences by females is unfortunate, since it leaves this country with an untapped resource. According to the Scientific Manpower Commission, only 5-11% (depending on the specific job) of females have occupations in scientific professions. The fact that a far larger percentage of Russia's professional scientific work force is female indicates that women are trainable in scientific areas. For example, 72% of the physicians in Russia are female compared to about 8% in the United States. In Russia, 30% of the engineers are female, whereas in the United States only 2% of the engineers are female.

On a variety of exercises, the 1972-73 results for females can only be considered incredible. Thirteen-year-olds were asked, "What does an electric company sell in units of kilowatt-hours?" and given the choices (1) atoms, (2) electrons, (3) energy, (4) radiation or (5) time. Forty-nine percent of the males correctly selected energy, compared to 35% of the females. The discrepancy in performance (14%) between males and females on this exercise doubled from the 1969-70 assessment. Also in the latest

science assessment, 12% fewer 13-year-old females than males knew why green plants are important or that the density of the human body most nearly equals the density of water. For both of these exercises in the 1969-70 assessment, the gap between males and females was 8%. In the 1972-73 assessment, 70% of the 13-year-old males knew that the use of a compass is related to the earth's magnetic field, compared to 54% of the females. This 16% female deficit also occurred in the first assessment.

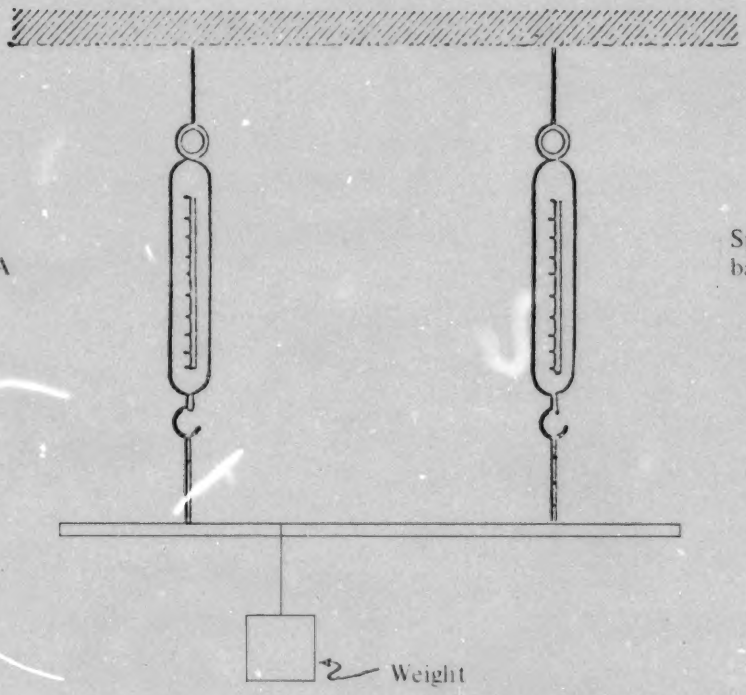
In the 1972-73 assessment, at age 17, 20% fewer females than males knew that it takes light about eight minutes to travel from the sun to the earth, and 10% fewer females than males knew that chemistry is principally a study concerned with matter. Both these percentages do represent a smaller male-female gap than in 1969-70. On an exercise dealing with alternating and direct current, 13% fewer females than males knew the answer in 1969-70. In the second assessment, this difference had increased to 18%.

Amazing, but rather typical of the science results, is the exercise on the following page. The female disadvantage has slightly decreased over time, yet there is still a 16-percentage-point difference.

It is hard to believe that females do not have at least a rudimentary knowledge of weights and balances by age 17. Unfortunately, it is easier to believe that they feel they are incapable of deciphering a "complicated" diagram.

In conclusion, two findings must be considered. Females at age 9 achieve about as well as males in math, science, social

Two identical spring balances are arranged as shown. Which spring balance will show the higher reading?



AGE 17

	1969-70		1973-74	
	Males	Females	Males	Females
A.	83%	66%	83%	67%

- A.
- B.
- Both spring balances will show the same reading.
- One cannot predict which spring balance will show the higher reading.
- I don't know.

studies and citizenship. This near-equality is soon replaced by a difference in favor of males. The disparity increases with

age, reaching an alarming size at the older ages. Also, there is some inconsistency in female performance. Females do as well as males, if not better, when the basic reading, writing and computational skills are assessed. Yet, they still achieve below males on a variety of the exercises assessed in math, science and the social sciences. These results in combination tend to suggest that the large, male advantage found by the adult ages is the result of different but systematic cultural reinforcements for the sexes.

Perhaps, historically speaking, few women have been involved in politics, science or mathematics. However, barriers based on sex alone are being lifted, and the visibility of women who are entering the traditionally male professions has increased. There is no reason that women who are doctors, lawyers and members of Congress should not provide examples to school-age females. Of course, if more women are to become involved, they should also understand they must be trained; they must take the courses and learn the concepts previously reserved for men. It is becoming increasingly important that women should be able to choose from a broader range of courses. Society and the schools must overcome a tendency toward influencing differential course election and actively work toward raising women's expectations. Women should be explicitly encouraged to consider training in professional fields at an early age. Curricula must be unbiased to give women a chance to make their own choices and the opportunity to reach their full potential.

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